



Nutrition 101: Forage Quality

Forage growers are always looking for ways to increase the yield potential and quality of their forage crops, such as alfalfa. Likewise, dairy producers consistently seek the highest-quality, most economical forage to feed their cattle.

This paper should answer many of your questions about cattle nutrition as it relates to forage quality. It will help you understand how alfalfa goes from seed to plant to feed. And, it will tell you how HarvXtra™ alfalfa — a reduced-lignin alfalfa from Forage Genetics International (FGI) — can help your customers grow a high-quality alfalfa crop with maximized yield potential and flexibility at harvest.

Why use alfalfa as an animal feed?

Alfalfa offers a number of advantages for cattle over other types of forage:

- Excellent fiber source
 - Chemical fiber: digested for energy
 - Physical/mechanical fiber: used to maintain proper digestion in ruminants (e.g., cattle)
- High-quality protein source
- Complementary to other types of forage or grains (e.g., corn silage or starchy feedstuffs)
- Cost effective (depending on region, availability and substitute ingredients)
- Palatable for cattle

Are there challenges to feeding alfalfa?

Though alfalfa offers many benefits as nutrition for cattle, there are some challenges associated with feeding it.

- Protein content is highly soluble, which means that the type and amount of protein needs to be carefully measured to maintain the diet's metabolizable protein supply.
- Fiber digestibility is highly variable and can be lower than that of other feedstuffs.
- Variation in nutritional content from cut to cut, even within the same field.
- Harvest challenges, including timing of cutting, weather, type of equipment used, can all lead to variation in quality and even risk.
- Consuming alfalfa with high K (potassium) during the dry period may cause milk fever in cows that have recently given birth (aka "fresh cows").

Why is alfalfa quality important?

Producing high-quality forage benefits dairy producers in three ways: greater profit, better performance and increased forage utilization.

- A one-unit increase in *in vitro* digestibility of NDF (see glossary) was associated with a 0.37 lb./day increase in dry matter intake (DMI) and a 0.55 lb./day increase in 4% fat-corrected milk yield per cow. (Oba and Allen, 1999)
- Greater DMI responses are observed with early lactation, higher-producing cows that are more bulk-fill limited. (Less noticeable with lower-producing cows.)

Forage fiber digestibility drives intake

Dry Matter Intake potential increases as NDF increases.

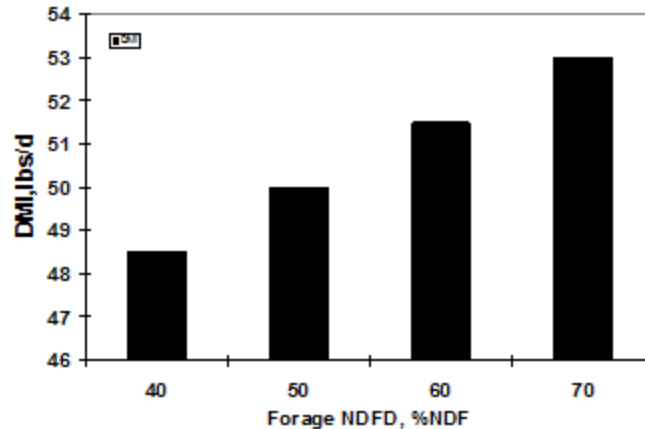


Figure 2. The relationship between forage NDFD content and dry matter intake in lactating dairy cows. Cloe and Allen, 1997.

Measuring forage quality

There are two primary methods for measuring forage quality:

1. Wet chemistry
 - Performed in a laboratory using chemical assay techniques
 - Traditional, time-proven
 - Accurate
 - Slow results (days)
2. Near-infrared reflectance spectroscopy (NIRS)
 - Several decades newer; uses instruments
 - Requires wet chemistry to create calibrations
 - Can be very accurate
 - Fast results (less than 24 hours)

Is forage quality testing regulated?

The National Forage Testing Association (NFTA), headquartered in Lincoln, Neb., was created to help improve the accuracy of forage testing and build grower confidence in testing animal feeds. Each year, the NFTA board updates the certification program for forage testing laboratories around the United States and Canada, as well as several outside of North America. NFTA-certified laboratories are evaluated six times a year.

What is lignin and why is it important?

Lignin is a structural component of the alfalfa plant that holds the plant upright. From an agronomic standpoint, it gives the alfalfa plant the opportunity to grow. However, lignin's woody texture makes the plant less digestible for cattle. Lignin levels increase with plant maturity.

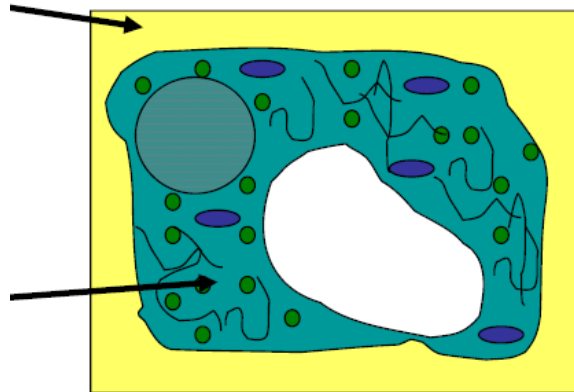
Anatomy of a plant cell

Cell wall (aka NDF)

- 20-60% digestible
- Cellulose
- Hemi-cellulose
- Lignin

Cell contents

- 100% digestible
- Non-structural carbohydrates (sugars & starch)
- Proteins (soluble & bound)
- Fats (lipids)
- Ash (minerals)
- Other



HarvXtra™ alfalfa

HarvXtra™ Alfalfa is a genetically-enhanced (GE) reduced lignin alfalfa. HarvXtra™ Alfalfa contains the biotechnology-derived trait developed to maximize alfalfa quality compared to commercially available alfalfa harvested at the same growth stage, by reducing the amount of lignin in the plant.

Potential benefits of HarvXtra™ alfalfa include:

1. Delayed harvest advantages:
 - Fewer harvests
 - Higher forage yield
 - Improved persistence
 - Increased harvest timing flexibility
2. Forage quality advantage:
 - Higher likelihood of harvesting premium-quality hay
3. Flexibility
 - Increased harvest timing flexibility
4. Advanced weed control
 - Roundup Ready® Technology

HarvXtra™ alfalfa was developed through a strategic partnership between FGI, The Samuel Roberts Noble Foundation, the U.S. Dairy Forage Research Center, and Pioneer, in conjunction with Monsanto Company. HarvXtra™ Alfalfa was deregulated by the United States Department of Agriculture (USDA) in November of 2014. We anticipate a limited introduction in 2016 in the Midwest and East.

Conclusion

Be sure to talk with your nutritionists, growers and producers about their nutritional goals. A successful animal nutrition program requires a team approach, so working closely with all involved parties to ensure that everyone is moving in the same direction is vital.

Glossary of forage terms

Forage practices involve a number of different terms and acronyms. Here are some of the most common.

Acid detergent fiber (ADF): Percentage of fiber that is soluble (dissolves) in weak acid. ADF is used to calculate digestibility.

Crude protein (CP): A mix of true protein and non-protein nitrogen.

Dry matter (DM): Percentage of cattle feed that is not water.

Dry matter intake (DMI): Amount of feed intake per animal per day on a moisture-free basis.

Lignin: A structural component of the alfalfa plant that holds the plant upright, but makes the plant less digestible for cattle. Lignin levels increase with plant maturity.

Neutral detergent fiber (NDF): Percentage of fiber in the plant that is not soluble in a neutral detergent solution. NDF is used to predict forage intake potential.

Neutral detergent fiber digestibility (NDFD): Percentage of NDF that can be digested. Can be estimated or measured via *in vitro* (lab test) or *in situ* (rumen test) digestion, or by estimating lignin content.

Relative feed value (RFV): A hay quality measurement.

Relative feed quality index (RFQ): Replaces RFV and ranks forages based on potential dry matter intake. NDFD predicts digestibility; NDF/NDFD predict intake.

Total digestible nutrients (TDN): Measurement of the available energy in feeds; calculation varies by region and nutritionist.

Total mixed rations (TMR): Weighing and blending feedstuffs into a complete ration that provides adequate nourishment for dairy cows.